The Use of Geographic Information Systems (GIS)
To Support Homeland Security

Recommendations For
# Emergency Management And Bioterrorism Response
# In Nebraska

## SUMMARY

Emergency management combines planning, preparation and the optimum resources to mitigate and respond to an event.  Good emergency management requires information that is accurate, current, timely, and quickly analyzed.   Much of the information used for emergency management has a spatial dimension, which is reflected in questions such as: "Where are critical facilities located?"  "What is the best route?"  "What is the area of impact?"  "How will the size of the impacted area change over time?" "How many people are in the affected area?"  "What resources are located close by?" GIS technology provides the tools for displaying and analyzing spatial data in order to answer questions such as these.

A year ago, NEMA began developing a basic GIS capability. The initial goal was to gather comprehensive data on the state's critical infrastructure, which is used for planning purposes.  NEMA's GIS project achieved its primary objective, but now faces several shortcomings.  These include:
1.  The databases use static information, which is difficult to keep current and becomes more outdated with time;
2.  Access to the data and the GIS tools is restricted to the NEMA offices;
3.  The GIS package includes extensive information on critical infrastructure, but lacks other databases and certain tools that would be useful for both planning and response management;
4.  Staff resources in the future will not be sufficient to support the existing system or enhance it.

After a meeting to discuss areas of mutual interest, NEMA requested assistance from the Nebraska GIS Steering Committee to help define specific needs and develop recommendations for utilizing these tools in times of an emergency.  The Department of Health and Human Services System (HHSS) has similar requirements.  The methodology for conducting the study used interviews with participants in a few key agencies, including NEMA, Department of Roads, Department of Environmental Quality, and Health and Human Services.  These initial meetings produced a set of findings and recommendations that are reflected in this report.

The findings and recommendations reinforce the overall conclusion that NEMA, HHSS, and other state agencies should work to enhance GIS support for emergency management functions.

## SCENARIOS

Timely, accurate information that is easily accessed and capable of being shared across federal, state, and local political jurisdictions is fundamental to the decision-making capability of those tasked with protecting life and property.  The real-time ability to map locations, visualize activity patterns, and understand the multi-layered context of emergency situations is essential to emergency management activities.

To illustrate, consider the potential release of hazardous or toxic materials into the air near a populated area. GIS information and analytic tools could be used to calculate and map the likely dispersion plume.  The projected dispersion plume could be overlaid and mapped on base maps showing streets and streams and could then extract the range of addresses likely to be impacted.  Critical or sensitive facilities (nursing

homes, schools, hospitals, etc.) within the dispersion area could be quickly identified and mapped.  If relocation is warranted and prudent, the GIS could be used to identify and map the best available relocation centers in the immediate vicinity.  The system could also be used to highlight those streets or access routes that might be contaminated by the hazardous release.  In the case of fires, other hazardous material sites in the immediate vicinity could also be identified and mapped. With advance planning and data development, tailored maps could be quickly generated and sent to first responders and to policy makers for decision support. Specialized maps for public information could also be generated at a moment's notice and sent to media outlets and/or made available on the web.

Similar uses of GIS technology would be applicable to scenarios involving bio-terrorism, managing disease outbreaks involving either humans or animals, and responding to radiological contamination.

The current state of geospatial information technology can provide decision-makers the data they need to confidently confront a wide variety of threats including natural disasters, terrorist attacks, sabotage and other similar crises.  However, the current implementation of that technology in Nebraska, across all the federal, state, and local agencies and jurisdictions necessary to fully coordinate an effective response, is seriously lacking in some areas.  Emergency management leaders and others should understand and implement the policy changes necessary to fully realize this technology's capability, and make the management decisions necessary to implement it on a statewide basis.


## FINDINGS

Below is a summary of observations and findings that arose from the interviews:

1. Neither of the two lead agencies (NEMA and HHSS) in Homeland Security and Bio-terrorism has sufficient experience or capabilities with GIS technology to build an enhanced GIS application without assistance.

2. Homeland Security and emergency planning and response are inherently interagency and intergovernmental in nature.  This is also true of the planning necessary for applying GIS technology to these situations.  Much of the geospatial data needed in an emergency situation is dynamic in nature and is maintained by a variety of agencies.  Rapid access and utilization of these varied datasets requires advance planning and the development of the infrastructure required to facilitate that data sharing.

3. Local emergency operations plans require street maps showing the location of hazardous materials and vulnerable facilities.  The maps are all on paper and are based on "windshield surveys" from 1989.

4. NEMA needs accurate maps of all roads and the ability to share them with responders in conjunction with setting containment boundaries.

5. A fairly high level of GIS coordination, cooperation, and data sharing currently exists in Nebraska.  However, the current coordination and data sharing processes are not structured nor sufficiently staffed to support reliable, rapid emergency response.  Most current GIS applications are focused on agency-specific missions. While many of these agency GIS applications utilize data from multiple agencies, few, if any of these applications, require immediate data accessibility and integration from other agencies, in contrast to what would be needed in many emergency situations.

6. Much of the geospatial data needed for Homeland Security and emergency response applications already exists and is maintained by a variety of agencies.  However, not all of the needed data exists, and some datasets, especially a statewide street centerline/address database, have such important emergency response uses that development should be a priority.  In some cases the needed information exists but needs to be documented or converted to a format that would facilitate its rapid integration into an emergency response GIS application.

7. DOR's Intelligent Transportation System project plans to develop a web-based application for displaying highway closure and points of traffic restriction. This information would be very useful for emergency management, especially if it could be integrated with other GIS information.

8. Following the 1993 floods in Nebraska, an interagency GIS working group compiled a report on "Information Needed for Disaster Planning and Response, 3/11/94." That report should serve as the starting point for developing a GIS application for emergency management.

9. The strategy for providing GIS support for Homeland Security should rely on dynamic access to information and databases, which are maintained by other agencies as part of their on-going operational responsibilities.

10. Security and authorization for different levels of access must be an integral part of any strategy.


## PRIORITY RECOMMENDATIONS

**Identify and Prioritize Geospatial Data Needs.** Initiate a systematic effort to work with key agencies to identify critically needed geospatial databases for homeland security and emergency planning and response by reviewing a variety of emergency response scenarios and identifying the likely data needs (i.e. development of county-specific emergency response or critical infrastructure manuals, radiological dispersion scenarios for a nuclear power plant incident, biological contamination of animal feedlot or other confinement facilities, etc.). Cross-reference the scenario specific data needs with other scenario data needs and the data needs of other emergency response agencies to identify priority/critical databases. Determine the current availability and quality of priority/critical databases to identify existing data deficiencies and define priorities for data development.

**GIS Technical Personnel Resources.** NEMA must have access to GIS technical staff, either based internally within NEMA or available to NEMA via contract with another agency or private entity, for on-going development and maintenance of GIS applications.

**GIS Data Integration Services and Technical Assistance.** In addition to the need to maintain a reasonable level of GIS personnel to develop and maintain on-going NEMA-related GIS applications and analysis, there is also a need for on-going data integration services that would facilitate the rapid integration of a variety of geospatial data sets. These types of on-going data integration services would be useful for the entire Nebraska GIS user community, but they would be particularly valuable in times of emergency so that NEMA personnel would not need to spend critical time performing these data integration functions. There is also an occasional need for specialized technical assistance to assist NEMA in developing special GIS and web-based GIS applications tailored to the specific homeland security and emergency response applications. The provision of these data integration services and specialized technical assistance could be a logical extension of an enhanced, enterprise-wide geospatial data clearinghouse.

**Homeland Security Emergency Response Data Team.** A Homeland Security Emergency Response Data Team should be created, with sufficient technical expertise, to assist NEMA with gathering and analyzing geospatial and other data in times of an emergency. In planning to meet these emergency data needs, this Data Team should assist NEMA to identify their likely data needs (including specific data elements or fields), identify the current availability status of needed data, assist with advance technical arrangement to insure the ready availability of that data from the multi-agency data stewards, and help make technical recommendations for the development of needed data that is not currently available.

**Collect Accurate Locational Coordinates on Key Facilities.** NEMA should participate in prioritizing key facilities and infrastructure and help initiate an interagency effort to collect accurate

locational coordinates for those facilities using GPS (Global Positioning Satellite) technology or other methodologies.

**Plume Dispersion Analysis.**  Insure the ready availability and capability of NEMA (or its affiliated response agencies) to conduct a plume analysis to plot the probable geospatial dispersion of toxic or radioactive chemicals in the atmosphere.  Insuring this capability would include ready access to the related data, the compatible hardware and software, and the technical expertise.

## OTHER RECOMMENDATIONS

**Nebraska Geospatial Data Clearinghouse.** The development of an enhanced, enterprise-wide Nebraska geospatial data clearinghouse which would provide reliable, ready access (via dynamic data links or direct data repository) to the most current and accurate versions of a wide variety of geospatial databases which might be needed for rapid emergency response, but which are maintained by a variety of state, local and federal agencies (i.e. road networks - NDOR, streams - NDNR, hazardous materials – NDEQ, critical facilities - HHSS, etc.)

**Statewide Street Address Database.** NEMA should help sponsor other geospatial databases that it needs to meet its requirements.  The highest priority need is for a statewide street address database, which would serve a wide range of homeland security, bioterrorism, and emergency planning and response applications. A statewide road-street centerline/address database would allow for integrating and mapping a wide variety of existing databases that have street address fields in the database.  Much of state and local government's existing data is referenced by street addresses.  For maximum utility such a street address database should be available to share with all interested parties and not be constrained by private data licensing agreements.

**Integrate Data Needs Into Emergency Response Planning Drills.** Emergency response planning drills should include the data, analytical tools, and access for responding to emergency situations.

**Data Stewardship Agreements.** Work with the Nebraska GIS Steering Committee to define agreements among state, federal, or local agencies for the responsibilities of coordinating the on-going maintenance and upgrading of specific, critical geospatial databases (i.e. NDOR for highway and street centerlines, NDNR for streams, etc.) and their distribution to make it more likely that in an emergency the various actors will have both the same and best available data.

**Define Specific Interagency Data Coordination Protocols.** Define specific database coordination initiatives between NEMA and other agencies that develop and/or maintain geospatial databases needed by NEMA which outline common data identifiers, feedback loops for data updating, and other common data standards to facilitate data sharing and rapid data access and integration (i.e. DEQ-NEMA on hazardous material sites, NDOR-NEMA on roads and streets and possibly addresses, etc.)

**Security and Remote Access**.  Authorized personnel should have secure access to information any time, anywhere, and any place.

## NEXT STEPS

1. NEMA will assign a planner to work on the first priority of identifying and prioritizing geospatial data needs. This will include coordinating with other state agencies and the GIS Steering Committee.
2. NEMA will present this strategy to the Homeland Security Policy Group and the Homeland Security Leadership Group.
3. The Geospatial Data Sharing Subcommittee of the GIS Steering Committee will assist NEMA in working on this strategy.
4. HHSS will consider whether to provide funding for identifying and prioritizing geospatial data needs. This work effort should include developing one or more initial GIS applications serving bio-terrorism needs, including plume analysis.